SUBCOURSE
EN5154

EDITION
A

US ARMY ENGINEER CENTER AND SCHOOL

ESTIMATE MATERIALS FOR A WALL FORM

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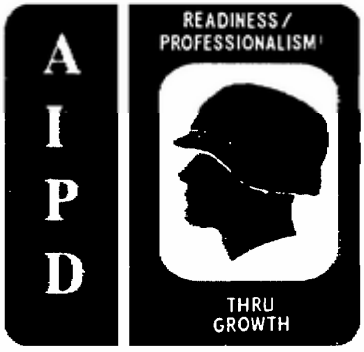
THE ARMY INSTITUTE FOR PROFESSIONAL DEVELOPMENT

ARMY CORRESPONDENCE COURSE PROGRAM



ESTIMATE MATERIALS FOR A WALL FORM

Subcourse EN5154
EDITION A

United States Army Engineer School
Fort Leonard Wood, Missouri 65473

3 Credit Hours

Edition Date: March 1996

SUBCOURSE OVERVIEW

This subcourse teaches you the basic principles of estimating the amount of materials needed to construct a wall form for concrete. In this subcourse, you will be shown the principal formula used to compute the exact amount of materials needed to complete the wall form. Work must be accomplished in a manner consistent with environmental laws and regulations.

There are no prerequisites for this subcourse.

The lesson in this subcourse reflects the doctrine that was current at the time it was prepared. In your own work situation, aways refer to the latest publication.

Unless otherwise stated, the masculine gender of singular pronoun is used to refer to both men and women.

TERMINAL LEARNING OBJECTIVE:

ACTION:	You will identify procedures to determine the amount of material needed to construct a wall form.
CONDITION:	You will be given this subcourse and an Army Correspondence Course Program (ACCP) examination response answer sheet.
STANDARD:	To demonstrate competency of this task, you must attain a minimum score of 70 percent on the subcourse examination.

TABLE OF CONTENTS

LESSON

ESTIMATE MATERIALS FOR A WALL FORM

Critical Task: 051-199-4014

OVERVIEW

LESSON DESCRIPTION:

In this lesson, you will learn to estimate material for each of the five components needed to construct a wall form for concrete. You will estimate the amount of sheathing, the number of studs, the number of wales, the amount of bracing, and the amount of tie wire.

TERMINAL LEARNING OBJECTIVE:

ACTION: You will complete a material estimation for sheathing, studs, wales, bracing, and tie wire. You will compute the amount of material needed to construct a wall form for concrete.

CONDITION: You will be given the material contained this lesson.

STANDARD: You will correctly answer practice exercise questions at the end of this lesson.

REFERENCES: The material contained in this lesson was derived from the following publications: FM 5-34, FM 5-426, FM 5-742, STP 5-12B1-SM, and STP 5-12B24-SM-TG.

INTRODUCTION

One of the basic skills in carpentry is the ability to estimate the amount of materials needed to construct a wall form for concrete. A carpenter must be able to determine the amount of materials needed to ensure that enough materials are on hand to complete the project. In this lesson, you will be shown how to compute the amount of material needed to build this structure.

1-1. Estimate the Amount of Sheathing.

The types of sheathing addressed in this section are cut board and plywood. Use the following formulas to determine how much material you need to build a form:

FORMULA (Cut-board):

$$\textit{Amount of cut-board sheathing} = 2\left[\frac{(L \times H)}{W_S}\right] + 2\left[\frac{(W \times H)}{W_S}\right] + 20\%WF$$

2 = *number of sides and ends*
L = *length of form, in feet (ft)*
H = *height of form, in ft*
W = *width of form, in ft*
W_S = *width of sheathing, in inches (in)*
WF = *waste factor*

EXAMPLE:

Determine the amount of sheathing that is required for a form 35 feet long, 4 feet wide, and 10 feet high using 1-by-4 cut-board sheathing.

ANSWER:

$$2\left[\frac{(35 \times 10)}{4}\right] + 2\left[\frac{(4 \times 10)}{4}\right] = 2\left[\frac{350}{4}\right] + 2\left[\frac{40}{4}\right] =$$

NOTE: Convert total numbers to inches before dividing.

$$2\left[\frac{(350 \times 12)}{4}\right] + 2\left[\frac{(40 \times 12)}{4}\right] = 2\left[\frac{4{,}200}{4}\right] + 2\left[\frac{480}{4}\right] =$$

$2(1{,}050) + 2(120) = 2{,}100 + 240 = 2{,}340$ *linear inches (lin in)*

NOTE: To convert inches to feet, divide by 12.

$$\left[\frac{2{,}340}{12}\right] = 195 \text{ linear feet (lin ft)}$$

add 20% WF

$195 \times 0.20 = 39$

$195 + 39 = 234$ *lin ft of 1-by-4 sheathing*

FORMULA (Plywood):

$$\text{Amount of plywood sheathing} = \frac{2(W \times H) + 2(L \times H)}{32} + 10\%WF$$

2 = *number of sides and ends*
W = *width of form, in ft*
L = *length of form, in ft*
H = *height of form, in ft*
32 = *square feet (sq ft)(a constant)*
32 *sq ft* = *surface area of a sheet of 4-by-8 plywood*
WF = *waste factor*

NOTE: Carry all division out two decimal places; do not round off before obtaining the answer. The final answer cannot contain decimals or fractions; therefore, it must be rounded up to the next whole number.

EXAMPLE 2:

Determine the amount of sheathing required for a form that is 50 feet long, 5 feet wide, and 8 feet high using 3/4-inch plywood sheathing.

ANSWER:

$$\frac{2(5 \times 8) + 2(50 \times 8)}{32}$$

$$\frac{2(40) + 2(400)}{32}$$

$$\frac{80 + 800}{32}$$

$$\frac{880}{32} = 27.5 \text{ sheets;}$$

add 10% *WF*

$$27.5 \times 0.10 = 2.75$$

27.5 + 2.75 = 30.25, *use* 31 *sheets*

1-2. Estimate the Number of Studs.

Use the following formula to determine the quantity of studs based on the measurement of the structure. Materials for studs are available in 8-, 10-, and 12-ft lengths. Choose the most economical size for the job.

FORMULA:

Number of studs for the form = 2(n + one end) + 10%WF

n = number of studs required for one side
WF = waste factor
2 = number of sides and ends

EXAMPLE:

How many 8-foot studs are required for a form that is 8 feet high with 40 studs on one side and 4 studs on one end?

ANSWER:

2(40 + 4) = 2(44)

88 *studs required*

add 10% *WF*

88 × 0.10 = 8.8

88 + 8.8 = 96.8

use 97 studs

1-3. Estimate the Number of Wales.

Use the following formula to determine the number of wales needed:

FORMULA:

$$\textit{Number of wales for the form} = 2\left[\frac{L}{Lw}+\frac{W}{Lw}\right] \times N \times 2 + 10\%WF$$

2 = *2 sides*
L = *length of form*
Lw = *length of wales*
W = *width of form*
2 = *2 wales per side (a constant)*
N = *number of wales for height*
WF = *waste factor*

EXAMPLE:

Determine the number of wales that are needed for a form 40 feet long and 8 feet wide, using 8-foot lumber and 8 wales on each side.

ANSWER:

$$2\left[\frac{40}{8}+\frac{8}{8}\right] \times 8 \times 2$$

$$2\left[\frac{48}{8}\right] \times 8 \times 2$$

$$2(6) \times 8 \times 2$$

$$12 \times 8 \times 2 = 192 \textit{ lin ft}$$

add 10% *WF*

$$192 \times 0.10 = 19.2$$

$$192 + 19.2 = 211.2, \textit{ use } 212 \textit{ wales}$$

1-4. Estimate the Amount of Bracing.

The amount of bracing required for a form may vary from a few stakes driven into the ground to a very elaborate scaffold bracing system. Some general guidelines are: forms over 8 feet high should have scaffold-type bracing; braces should be placed approximately 5 feet apart on the sides and ends; and Table 1-1, page 1-9, should be used if ends are less than 15 feet in width. When computing the amount of bracing it is easier to work in nine small steps.

FORMULA 1 (includes steps 1-9):

Step 1. ***Draw a small sketch of the brace. Use Figure 1-1, page 1-10, as a guide.***

Step 2. ***Determine the amount of bracing for one brace on each side =***

$$2(D \times ft) + (H + ft) + (V \times ft) + B$$

D = number of diagonal braces times length
H = number of horizontal braces times length
V = number of vertical braces times length
B = length of the brace stake
2 = number of sides

Step 3. Determine the number of braces for one side =

$$\frac{\textit{Length of the form}}{\textit{5-ft brace spacing}}$$

NOTE: The final answer cannot contain decimals or fractions; therefore, it must be rounded up to the next whole number. It is better to move the last two braces in and overbrace than to underbrace.

Step 4. Multiply the amount for one brace (Step 2) times the number of braces on a side.

Step 5. Determine the number of braces on each end by using Table 1-1.

Step 6. Multiply the amount for one brace (Step 2) times the number of braces on an end (Step 5).

Step 7. Add the amount of bracing for the sides (Step 4) to the amount of bracing for the end (Step 6) to obtain the total bracing.

Step 8. Compute a 10% WF.

Step 9. Add the WF (Step 8) to the total bracing (Step 7).

EXAMPLE 1 (for short forms 8 feet and under):

Determine the amount of bracing required for a form that is 35 feet long, 3 feet wide, and 7 feet high, with 5-foot horizontal and vertical braces, an 8-foot diagonal brace, and a 2-foot brace stake.

Table 1-1. Number of braces on each end

Form Width	Form Height	Number of Braces
1 foot	--	1
Less than 3 feet	Under 5 feet	1
Less than 3 feet	5 feet or more	2
3 to 15 feet	--	3

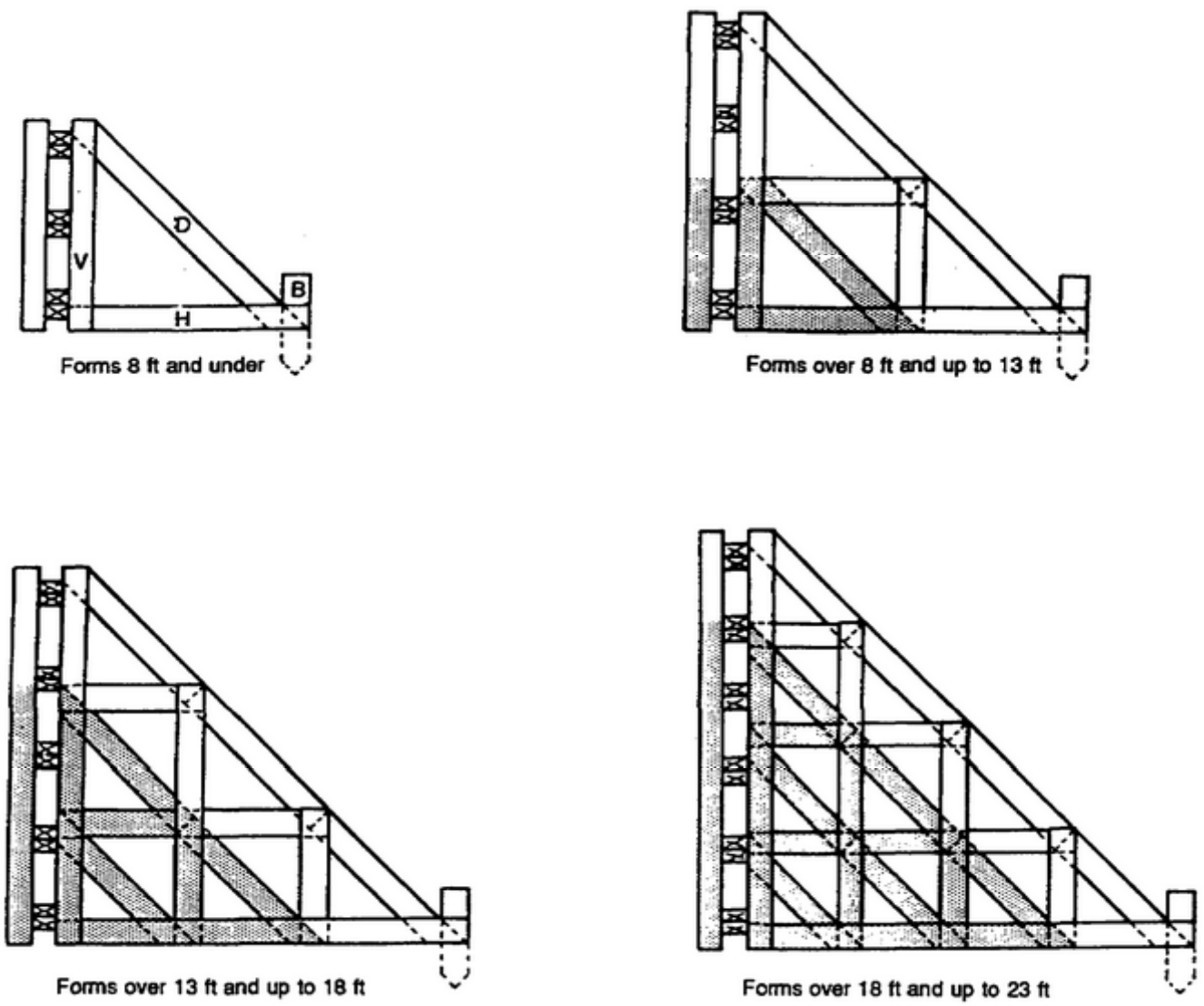


Figure 1-1. Scaffold-type bracing

ANSWER 1:

1. *Sketch the brace.*

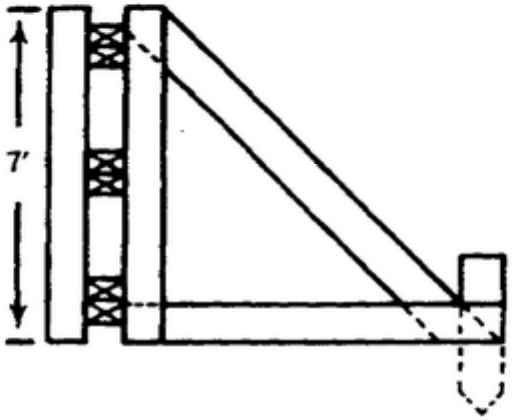


Figure 1-2. Brace

2. *Amount of bracing for one brace on each side* =

$$2(D \times 8) + (H \times 5) + (V \times 5) + B$$

$$2(1 \times 8) + (1 \times 5) + (1 \times 5) + 2$$

$$2(8 + 5 + 5 + 2)$$

$$2(20) = 40 \text{ ft}$$

3. *Determine the number of braces for one side* = $\frac{L}{5} = \frac{35}{5} = 7$

4. *Amount of bracing for the sides* = 40 × 7 = 280

5. *Number of braces for each end* = 3

6. *Amount of bracing for the ends* = 40 × 3 = 120

7. *Total bracing* = 280 + 120 = 400

8. 10% *WF* = 400 × 0.10 = 40

9. *Amount of bracing for the form* = 400 + 40 = 440 *lin ft*

EXAMPLE 2 (for tall forms 13 to 18 feet):

Determine the amount of bracing required for a form that is 50 feet long, 4 feet wide, and 16 feet high, with 5-foot vertical and horizontal braces, 8-foot diagonal braces, and a 3-foot brace stake.

ANSWER 2:

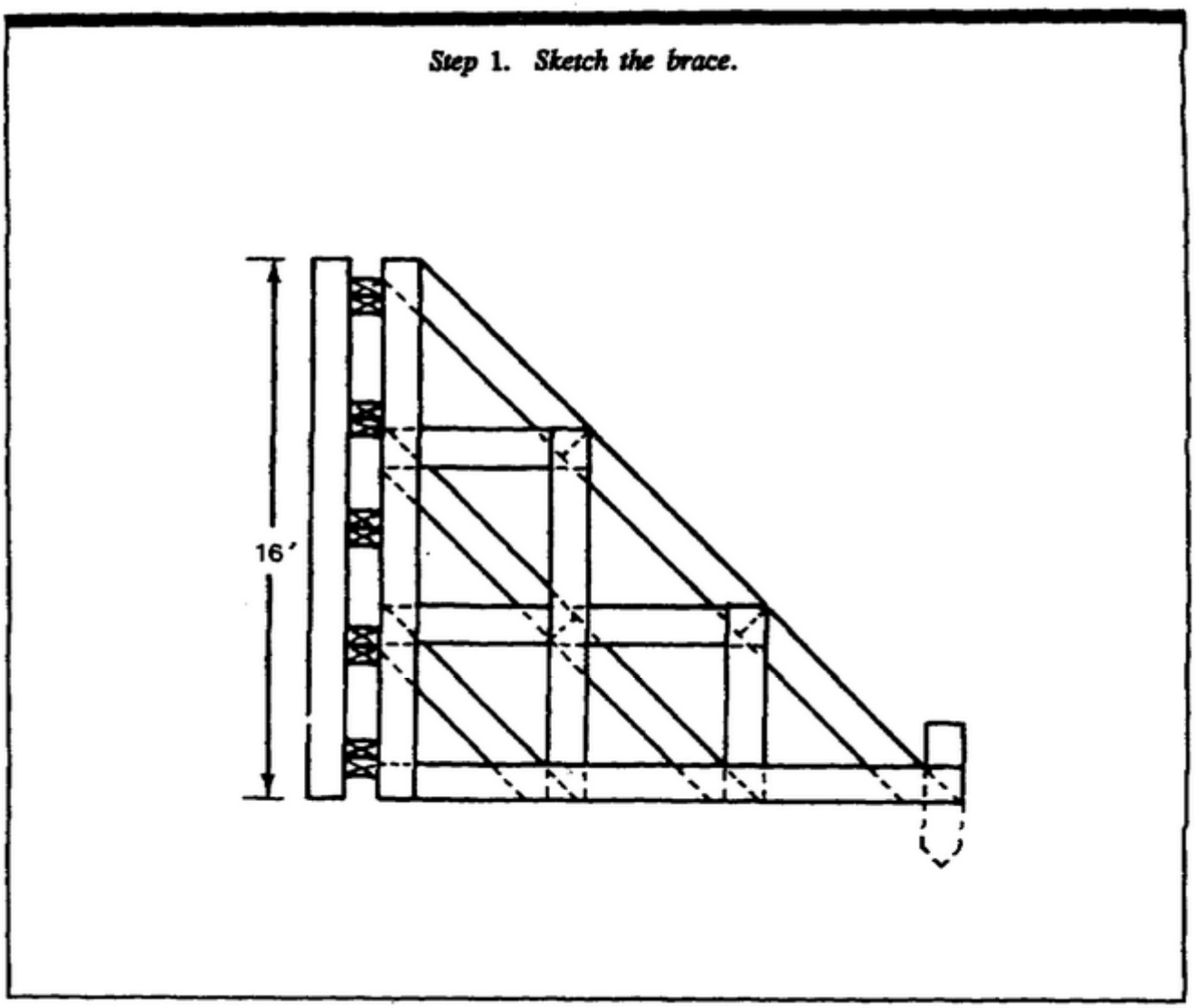


Figure 1-3. Brace sketch

Step 2. Amount of bracing for one brace on each side =

$$2[(D \times 8) + (H \times 5) + (V \times 5) + B] =$$

$$2[(6 \times 8) + (6 \times 5) + (6 \times 5) + 3] =$$

$$2[48 + 30 + 30 + 3] =$$

$$2[111] =$$

$$222 \text{ ft}$$

Step 3. Number of braces for one side $= \frac{L}{5} = \frac{50}{5} = 10$

Step 4. Amount of bracing for the sides $= 222 \times 10 = 2{,}220$

Step 5. Number of braces for each end $= 3$

Step 6. Amount of bracing for the ends $= 222 \times 3 = 666$

Step 7. Total bracing $= 2{,}220 + 666 = 2{,}886$

Step 8. 10% *WF* $= 2{,}886 \times 0.10 = 288.6$

Step 9. Amount of bracing for the form $= 2{,}886 + 288.6 = 3{,}174.6$, *use* 3,175 *lin ft*

1-5. Estimate the Amount of Tie Wire.

The final step in determining the materials required in form design is to estimate the amount of tie wire required, using the three formulas below. Figure 1-4, page 1-17, shows the wire installation.

FORMULA 1:

Amount of tie wire required for one tie =

(a) Add the following:

Width of form (in)
Thickness of sheathing times 2
Thickness of stud
Width of stud times 2
Thickness of wale times 2
Width of the wale times 2

(b) Multiply by 2 (for 2 sides)

(c) Add 12 in (to allow for twisting the ends)

(d) Convert answer to ft

EXAMPLE 1:

Determine the amount of tie wire required for a form that is 20 feet long, 12 feet high, and 3 feet wide, with 2-by-4 studs and wales, 1-inch sheathing, tie-wire spacing of 28 inches, and 6 wales on each side.

FORMULA 2:

$$\textit{Number of ties required} = \left[\frac{L(ft) \times 12\ in + 1)}{TWS}\right] N$$

L = *length of form*
N = *number of wales on one sides*
in = *inches*
TWS = *tie-wire spacing*

FORMULA 3:

Amount of tie wire required for the form =

$$TW \times N$$

TW = *amount of tie wire required for one tie*
N = *number of ties required*

NOTE: The final answer cannot contain decimals or fractions; therefore, it must be rounded up to the next whole number.

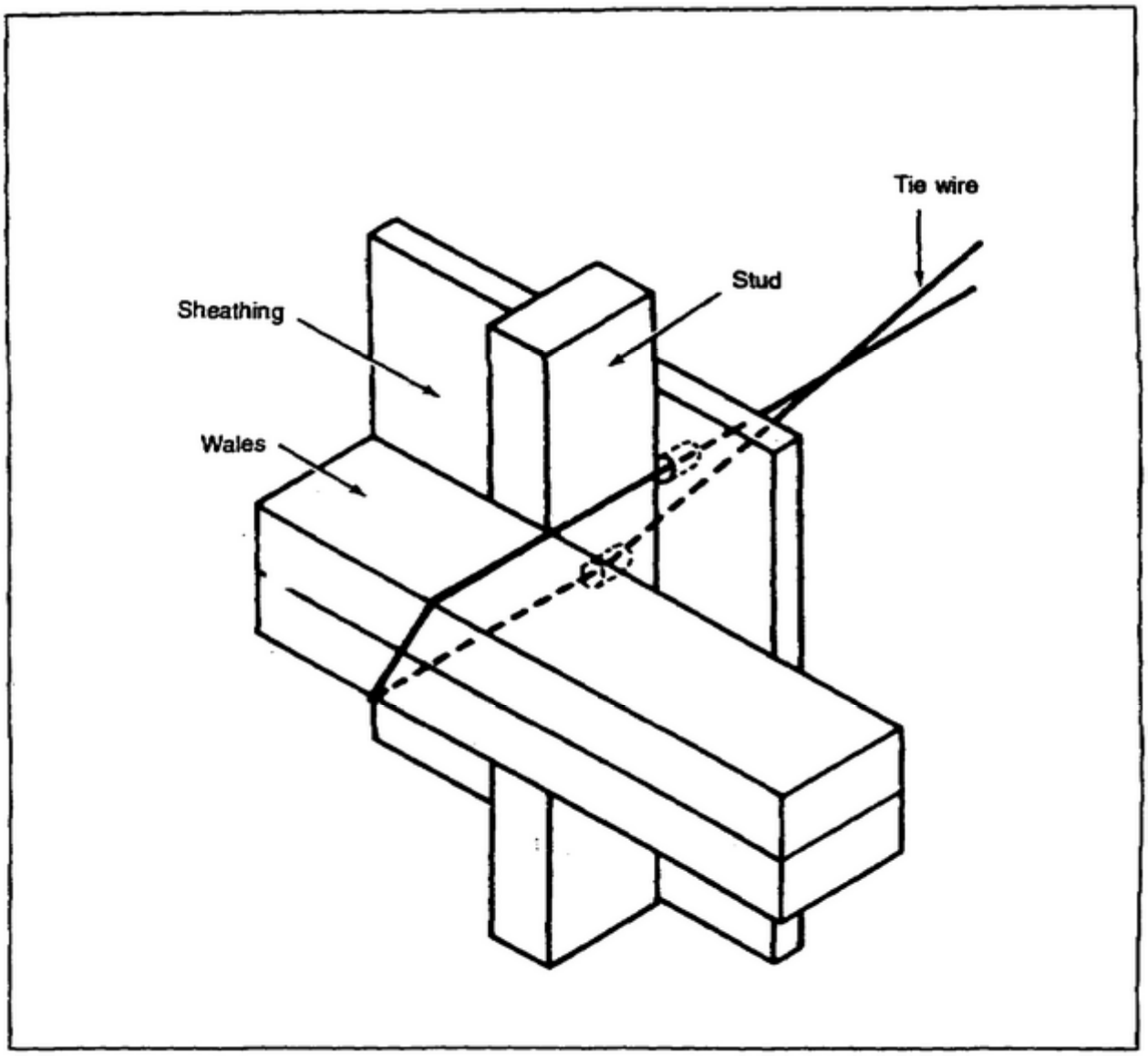


Figure 1-4. Tie-wire installation

ANSWER 1:

Amount of tie required for one tie =

(a) Add the following:

36 *in* = *width of the form*
2 *in* = *thickness of the sheathing* × 2
2 *in* = *thickness of the stud*
8 *in* = *width of the stud* × 2
4 *in* = *thickness of the wale* × 2
+8 *in* = *width of the wale* × 2
60 = *total amount of inches*

(b) 60 × 2 = 120 *in (for 2 sides)*

(c) 12 *additional ft for tying the ends*

(d) 132 *in divided by* 12 *in* = 11 *ft*

ANSWER 2:

Number of ties required =

$$\left[\frac{20 \times 12}{28} + 1\right] \times 6 =$$

$$\left[\frac{240}{28} + 1\right] \times 6 =$$

$$[\,9 + 1] \times 6 =$$

$$10 \times 6 =$$

60 ties required

ANSWER 3:

Amount of tie wire required for the form =

60 ties required × 11 *ft for each tie =*

660 ft of tie wire

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PRACTICE EXERCISE

The following items will test your grasp of the material covered in this lesson. There is only one correct answer to each item. When you complete the exercise, check your answer with the answer key that follows. If you answer any question incorrectly, study again that part of the lesson which contains the portion involved.

1. Determine the amount of 1-by-4 cut-board sheathing in linear feet that is required for a form, with a length of 33 feet, a width of 3 feet, and a height of 8 feet.

   A. 2,050

   B. 2,060

   C. 2,074

   D. 2,094

2. With a form length of 24 feet, a width of 5 feet, and a height of 12 feet, determine the amount of plywood sheathing required.

   A. 22

   B. 23

   C. 24

   D. 25

3. If you are given 34 studs for one side and 5 for each end, how many 8-foot studs are required for a form 8 feet high?

   A. 82

   B. 84

   C. 86

   D. 88

4. How many 12-foot studs are required for a form 12 feet high if 22 studs are used on one side and 6 on one end?

   A. 60

   B. 62

   C. 63

   D. 65

5. If you have a form 33 feet long, 8 feet high, and 3 feet wide, how many wales are needed using 12-foot lumber and 3 wales on each end?

   A. 34

   B. 36

   C. 38

   D. 40

6. Determine how many wales are needed for a form 24 feet long, 12 feet high, and 5 feet wide, if you use 8-foot lumber and 5 wales on each side.

   A. 75

   B. 80

   C. 83

   D. 85

7. Estimate the amount of bracing required in linear feet for a form that is 45 feet long, 12 feet high, and 10 feet wide, with diagonal braces 8 feet long, horizontal and vertical braces 5 feet long and a brace stake 2 feet long.

   A. 1,479

   B. 1,483

   C. 1,503

   D. 1,518

8. Estimate the amount of bracing required for a form in linear feet that is 100 feet long, 18 feet high, and 2 feet wide, with vertical and horizontal braces 5 feet long, diagonal braces 8 feet long, and a brace stake 3 feet long.

   A. 5,360

   B. 5,373

   C. 5,380

   D. 5,393

9. If you are given a form that is 33 feet long, 8 feet high, and 3 feet wide, with 2-by-4 studs and wales, 1-inch sheathing, a tie-wire spacing of 12 inches, and 3 wales on each side, how much tie wire is required, in feet?

   A. 1,110

   B. 1,122

   C. 1,127

   D. 1,134

10. What amount of tie wire is required, in feet, if you are given a form that is 45 feet long, 12 feet high, and 10 feet wide, with 4-by-4 studs and wales, 3/4-inch sheathing, a tie-wire spacing of 10 inches, and 4 wales on each side?

    A. 5,720

    B. 5,760

    C. 5,765

    D. 5,770

PRACTICE EXERCISE

ANSWER KEY AND FEEDBACK

Item	Correct Answer and Feedback
1. C	2,074 . . . . (page 1-2)
2. C	24 sheets . . . . (page 1-3)
3. C	86 8-foot studs . . . . (page 1-5)
4. B	62 12-foot studs . . . . (page 1-5)
5. D	40 12-foot wales . . . . (page 1-6)
6. B	80 8-foot wales . . . . (page 1-6)
7. A	1,479 linear feet . . . . (page 1-7)
8. B	5,373 linear feet . . . . (page 1-7)
9. B	1,122 feet of tie wire . . . . (page 1-15)
10. A	5,720 feet of tie wire . . . . (page 1-15)